



FOREST HEALTH PROTECTION

Pacific Southwest Region

South Sierra Shared Service Area

FHP Report No. C05-1

3420
October 7, 2004

Evaluation of the White Fir Involved in the Holmes Investigation, Sequoia and Kings Canyon National Parks

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Background

On October 5, 2004, the Holmes Investigation Team requested that technical specialists John Wenz, Entomologist and John Pronos, Plant Pathologist, (USDA Forest Service, Forest Health Protection, South Sierra Shared Service Area, Stanislaus National Forest, Sonora, CA) assess the condition of the white fir tree involved in the fatality associated with implementation of the Grant West Prescribed Burn. This evaluation was conducted on October 6, 2004.

Observations

The subject white fir (*Abies concolor*) is 132 feet tall, 57.9 inches in diameter at breast height (DBH) and one of the largest trees in the area (Figure 1). The entire tree was dead at the time of the evaluation, and based on crown condition, dead needle retention and branch dieback, had likely died within the past one to two years. The portion of the tree that broke out and caused the fatality was consumed by fire and was not available for examination.

Older dead branches were scattered throughout the length of the crown and only a few dead needles were still present on branches in the lower crown. The amount of debris present near the base of this white fir shows that branches have been falling out of it for several years (Figure 2). Some dead branches had broken loose of the bole and were hung up within the crown ("widow makers") (Figure 3). Remnants of true mistletoe (*Phoradendron* sp.) plants were observed in the upper 10 % of the bole, and although this common parasite of white firs does not kill entire trees, it does contribute to the death of tree tops. There was no dead needle retention visible in the top 20% of the bole suggesting that it had died prior to the death of the entire tree. This may have been influenced by Douglas-fir tussock moth, *Orgyia pseudotsugata* (Lepidoptera; Lymantriidae) defoliation during the 1997-1999 outbreak that occurred in the general vicinity of Grant Grove.

The original leader is no longer present, as evidenced by lack of a vertically continuous main stem and the presence of dead lateral branches that had assumed dominance (volunteer tops) and continued to grow for a few years before also being killed (Figure 3). Death of the original top and the more recent dieback of the secondary laterals probably resulted from attack by the fir engraver, *Scolytus ventralis* (Coleoptera: Scolytidae), although positive identification was not possible by observation from the ground. The fir engraver commonly attacks true firs throughout western North America causing top kill, branch kill and, if attacks are numerous enough along the bole, whole tree mortality. Other less aggressive engraver species in the same genus, including *S. praeceps*, *S. abietis* and *S. subscaber*, may also be involved with the top and branch dieback. Through time, tops and laterals killed by the fir engraver will lose structural integrity and eventually break off due to the effects wind or snow. The wood of dead white firs is highly susceptible to decay, which causes rapid deterioration. The decayed wood is weak and, when dry, very easy to ignite.

Extensive boring dust was observed in bark crevices around 100% of the bole circumference at the base of the subject tree up at least 15 to 20 feet above ground level (Figure 4). Examination under the bark revealed the presence of extensive, well developed feeding galleries, probably caused by larvae of the roundheaded fir borer, *Tetropium abietis* (Coleoptera: Cerambycidae). Oval holes in the sapwood indicated the larvae had also tunneled into the sapwood. A few round exit holes were present in the outer bark suggesting that at least some of the woodborer adults had completed development and emerged. In addition, very small round holes in the sapwood indicated the presence of *Platypus wilsoni* (Coleoptera; Platypodidae), an ambrosia beetle that mines in the sapwood and heartwood of dead and dying fir. The outer sapwood exhibited superficial decay and termites were also observed working in the sapwood. These secondary insects typically colonize white fir following successful attack by the fir engraver.

Several other dominant and co-dominant white fir were present in the stand in the vicinity of the examined tree. Many of these firs also exhibited broken tops, varying degrees of top and branch dieback and true mistletoe infections similar to the subject fir (Figures 5 and 6). In addition, several nearby firs of various sizes were either dead or had very poor crown condition and needle retention likely resulting from defoliation during the recent Douglas-fir tussock moth outbreak and/or attack by fir engravers.

Discussion and Conclusions

The condition of, and associated factors found on, the subject white fir, are typical of situations commonly present in mature mixed conifer-true fir stands throughout the Sierra Nevada. Many decadent, large, old white firs have similar characteristics. Such conditions usually result from a variety of interacting biotic and abiotic factors that tend to weaken and reduce tree vigor rather than a single cause. Trees thus affected are predisposed and at higher risk to successful attack by bark and engraver beetles. In the case of the white fir under consideration, the interacting factors included attack by the fir engraver, true fir mistletoe, tree age, probable decay, periodic moisture stress and possibly defoliation by the Douglas-fir tussock moth.

The examined tree had been dead for probably one to two years at the time of the Grant West Burn. The top 20% of the tree had likely been dead for a few years prior to the death of the lower portion. Dead branches were scattered throughout the crown, and older ones had already broken loose from the bole. Such dead tops and branches eventually become structurally unsound.

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